stitution of the sun; this problem is so difficult, that it is necessary to leave to every one the responsibility of his own ideas on this subject. I ask, then, for permission to decline any critical notice of this part of the book.

I must mention also a useful description, illustrated with maps, of the telluric and atmospheric lines from the works of Brewster, Gladstone, Angström, and Janssen.

The remaining part of the book is entirely devoted to the most delicate applications of spectrum analysis to astronomy. A preliminary description of the sun-spots, faculæ, and other peculiarities of the surface of the sun, of the prominences round the disc, and so on, is given before the spectroscopic process for analysing these appearances is introduced, and enables the reader to understand very well the difficulties of the problem and the interest of its solution. I must mention especially the interesting account of the three total solar eclipses of 1868, 1869, 1870. A large series of drawings and photographic *fac similes* give the best idea of the phenomena, and show the improvements due to photography and spectroscopy; the relatively great extent devoted to this account is justified by the importance of the subject; the spectrum analysis of the prominences is in fact one of the most considerable results obtained for a long time in the sciences of cosmogony.

Now from this discovery of Janssen's it is easy to observe every day the solar prominences by utilising the bright lines of their spectrum. Janssen's method, discovered in India soon after the eclipse of 1868, was independently discovered again some weeks after by Lockyer, who has the real merit of announcing two years before the possibility of such an important observation, and would very likely have had the honour of priority if he had had beforehand the material means of carrying out his designs.

Schellen's book contains a complete account of the improved telespectroscopes of Lockyer, Respighi, Secchi, Huggins, Janssen, Young and Zöllner, and a beautiful series of coloured sketches, representing some daily observations of prominences all varying, but truly characteristic of their form. I must confess, however, that some of those beautiful pictures seem to me rather too much embellished by the imaginative fancy of one of the observers. The sun-spots and faculæ observed with a telespectroscope give a good number of new facts which have led Lockyer and Secchi to the most important inductions upon the constitution of the sun.

The spectroscope, as it is known, is able to give an exact measurement of the proper velocity of the luminous bodies. A German physicist, Doppler, deserves to be mentioned as the first who called the attention of astronomers to this subject, though a good number of his assertions may be incorrect. After him, Fizeau, a French physicist, to whom we are indebted for the first determinations of the velocity of light on the surface of the earth, showed the errors of Doppler in a little paper not very well known, published in 1849 ("Bulletin de la Société Philomatique de Paris"), and calculated the apparent change of refrangibility which would be produced by the proper motion of some heavenly bodies; but no direct experiment was made before the complete application of spectrum analysis to the sidereal phenomena. In this way Schellen's book gives a good abstract of the works of Huggins and Secchi. In these researches the velocity of rotation of the sun was to be tested as a verification of the general law of the phenomenon. I ought to say, that, the rather discordant results want a theoretical analysis, because the problem seems to me, in the case of the sun, more complicated than it appears at first sight. However, the influence of the velocity of the gas streams, especially of hydrogen, which constitute the greater part of the prominences, is unquestionably verified by Lockyer's observations. In the same way Huggins has proved and determined the proper motion of Sirius by the apparent change of refrangibility of the F line.

The remaining part of the book is devoted to stellar and meteoric spectrum analysis. It is impossible to give a superficial notice of the beautiful researches of Huggins and Secchi, researches which are always going on; the reader will find with interest various important results of these studies—for instance the existence in many stars of a good number of terrestrial substances—hydrogen, nitrogen, magnesium, sodium, &c.

One of the most interesting facts is the observation of the temporary star which appeared in May 1866; the great brightness of the star was due, as indicated by the spectroscope, to an immense mass of incandescent hydrogen.

At the end of the work the author gives some very important observations of Huggins and others on the spectrum of nebulæ; the chief result is the possibility, with the aid of the spectroscope, of distinguishing by the composition of their light the true nebulæ from the clusters of stars.

Finally, a description of the spectrum of the aurora borealis, the identification of its bright lines with some bright lines of the solar corona, a description of various meteors, lightnings, and their spectra, show into what difficult objects this new branch of science has pushed its investigations.

On the whole, this book must be considered as a good type of a "popular work;" it deserves the attention of the public, and the esteem of scientific men; and finally, it recommends itself by a gracious side. It was translated into English by two ladies, who have had the double merit of giving a proof of their good scientific taste, and of showing an example of the help which their sex is able to afford to science.

CORNU

OUR BOOK SHELF

Health and Comfort in House-building. By J. Drysdale, M.D., and J. W. Hayward, M.D. (London: E. and F. Spon, 1872.)

Sewer-gas, and how to keep it out of Houses. By Osborne Reynolds, M.A. (London: Macmillan and Co., 1872.)

THE first of these works supplies a want long felt by that section of the public who are desirous of obtaining a good supply of fresh air in their houses, without being subjected to the cold draughts usually associated with almost every system of ventilation. The book is most carefully written, and is evidently the result of much thought, time, and intelligent labour. After reviewing very fairly the systems of ventilation which have been proved to be ineffectual for supplying fresh warm air to the whole of a house, although perhaps very appropriate for single rooms, we are told that the key-note of this new

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system consists in utilising the kitchen fire, which is almost constantly kept alight in summer and in winter. "Endeavour is made to prevent the air from entering the house at all except by the inlet provided in the lowest story of the house, with conditions available for the warming, cleaning, disinfecting, or otherwise improving the quality of the incoming fresh air, and regulating its quantity; the fresh air is then conducted into the central private hall, which is protected from smells, and all other means of pollution: it is from this private hall that the rooms draw their supply, even when the doors are shut. Having served its purpose in the rooms, the air is drawn off through the ceiling into the foul air chamber, and thence down and behind the kitchen fire, up the chimney-stack, and discharged high up in the open air, all possibility of back draught being prevented by the length and heat of the exhausting-syphon." It is a work which can be highly recommended to the officer of public health, the architect, and the householder, as a guide to the true principles of healthy ventilation. In "Sewer Gas; a Handbook on House-drainage," we have a very simple and original plan suggested for preventing noxious gases and exhalations from drains entering our houses. It is shown that these gases, being specifically lighter than atmospheric air, frequently ascend in pipes, and that they are also occasionally drawn in by the suction caused by the warmth of a house through accidental crevices in the drain pipes. It is proposed to remedy these evils by doing away with all traps except those connected with the pans of closets, and by placing a large trap in the pipe which connects the house drains with the sewer. A plan of this trap is given, showing that it is easily accessible, and can be cleaned at any time by even an inexperienced workman. The subject is one of even more importance than good ventilation. When we recollect that one of the most valued lives in Great Britain has been so recently imperilled from a mere defect in a system of drainage, we cannot too highly estimate the efforts of those who suggest, both by precept and experiment, the adoption of such measures as will ensure the safety of all sensible householders.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

Hindrances to Students of Mathematics

It was the opinion of Dr. Samuel Johnson that everything ought to be persecuted in order that we may know whether it is worthy to live or not. There is, doubtless, a good deal of truth in this opinion, and the idea or the man that cannot endure and overcome a considerable amount of difficulty is of but little value. Still there must be a reasonable limit to persecutions and difficulties, and hence I hope that the praiseworthy efforts of the English mathematicians to improve their text-books of geometry will be successful. In considering such a matter as the improvement of text-books, an extensive knowledge of the experience of all classes of students will be valuable, and as many of the mathematical books profess to be written for those who are not fortunate enough to have a teacher, an account of the difficulties which such a one has experienced may be of some interest.

1. I place first among these difficulties the practice common to nearly all mathematical writers, of restricting the number of axioms or fundamental assumptions, making them fewer than they naturally are. It is worse than useless to attempt to prove something that is self-evident, or which is so nearly so that it is impossible to make any proof illustrate it. In all such cases it would be better to state frankly and clearly that we make an assumption, depending on observation to justify it. An example of this superfluous proof may be found in many of the books on rational mechanics, where we are told that a body cannot move out of the place of the forces, because we know of no reason why it should move to one side rather than the other; therefore, &c. Of useless definitions we have an example in a popular work on arithmetic, where we are told that "time is the measurement of duration," and a few pages further on that "duration is a portion of time." Allied to this is the contemptible habit of those who explain, with kind condescension and with great detail, all insignificant matters, while at the same time they cover up or dodge by some such phrase as "it is evident" the really difficult points.

2. I do not object to a frequent and thorough application of the differential calculus in a text-book, and such an application seems to me better than the coarse processes under which this calculus is sometimes concealed; but there is a habit, common to young writers, of introducing forced and difficult demonstrations where more simple ones would be better. An illustration may be found in one of our best books on astronomy. In the first edition of this book the author gave a long and difficult demonstration of the well-known formulæ for the transformation of rectangular co-ordinates in a plane. The demonstration was made to depend on the solution of functional equations by means of the differential calculus, and is an awkward thing to place at the beginning of a text-book. In the second edition, having removed this demonstration and supplied its place by a simple one, the author has made the first chapter of his book the best synopsis of spherical trigonometry that I know of.

3. An error of the English text-books written by Cambridge men is, I think, the great number of examples given at the close of each chapter. At least one-half of these should be omitted. It is a great mistake to keep the student lingering over the never-ending questions of conic sections, of maxima and minima, &c., and to give him the habit of solving petty problems, when he should be led forward as soon as possible to the study of the memoirs of those who have created the science. In this connection it seems to me a mistake in treating the differential calculus to confine ourselves rigorously to the notion of a limit. Although the doctrine of limits may be the only logical foundation of this calculus, the student as he advances must soon become familiar with differentials, and it is well that he should make their acquaintance in his text-book.

4. A defect, perhaps of teaching rather than of text-book, is the ignorance of all American students of numerical and logarithm calculations, and from my slight observation I infer that such is the case also with English students. It is not uncommon to hear such calculations spoken of with contempt, but there is nothing that gives one a clearer idea of the meaning of analytical formulæ than to make a numerical application of them. In this matter it seems to me that the assistance of a teacher is of much more importance than in dealing with theoretical difficulties, since with these a student must generally be left to himself, while a little advice from a skilful computor will save the beginner much time and trouble.

5. Finally I mention, as a source of some confusion and perplexity to the student, the changes of notation and the introduction of new names. Some such change and inventions will be necessary with the progress of science, but any which tends to mar the symmetry of analytical expressions, and render less easy the reading of the great mass of mathematical literature that we already possess, should be avoided. To call a well-known function a "wonnumetonomy," or a "subcontra-wonnumetonomy," does not of course endow it with any new properties, or make its discussion one whit easier, although we may gain a slight advantage in the way of brevity of reference. For my own part I hope that this introduction of words of thundering sound, and the calculation of almost interminable formulæ, for which no more ingenuity is required than for a numerical calculation, is only premonitory to the invention of a calculus of operations which shall furnish us with shorter and more powerful methods of investigation. Asaph Hall

Washington, August 16

Jeremiah Horrocks

In the course of research (for literary purposes) concerning Jeremiah Horrocks, the astronomer, born at Toxteth, near Liverpool, 1619, I have been unable to discover his parentage. Could any of your readers help me in this matter?

London, Aug. 12 E.

The "Mors Electrique"

With reference to your notice of M. Sidot's "Mors Electrique," I may mention that in India it has been proposed to use Magneto Electricity for the purpose of starting a jibbing horse,

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